SPA CONTROL PANEL

12:36

48

46

→ 12

FIG. 1

14

18   FLOW RATE

16

110/220 VAC
INPUT

SYSTEM
INTERCONNECTION
PANEL

21   TEMP 2 (SPA)

20   TEMP 1 (HEATING ELEMENT)

22   Ph PROBE

PUMP

24

HEATER

26

BLOWER

28

LIGHT

30

MICROCOMPUTER
MAIN PROGRAM   80

42

82   KEYBOARD
MONITOR

PID
CONTROL   92

84   DISPLAY
CONTROL

OUTPUT
CONTROL   94

86   ALARM
CONTROL

INPUT
SCANNING   96

88   ANALOG
CONVERSION

pH
ALGORITHM   98

90   RTC
CONTROL

FIG. 4

FIG. 2

MICROCOMPUTER — 10

42

MAINTENANCE MODE

16 — 110/220

SPARE

SPARE

14 — SYSTEM INTERCONNECT PANEL

44 — EPROM MEMORY

DIGITAL IN (PROCESS) — 74

32 — RAM MEMORY

DIGITAL OUT (PROCESS) — 58

26 — HEATER
24 — PUMP 1
PUMP 2 (HIGH)
28 — BLOWER
30 — SPA LIGHT

34 — RTC

ANALOG IN — 36

38 — DISPLAY INTF

SIGNAL COND — 37

20 — TEMP 1
20 — TEMP 2
22 — pH
SPARE
18 — FLOW RATE

39

40 — DISPLAY

KEYBOARD INTF — 56

KEYBOARD — 48

FIG. 8

READ AUTO VOLT DETECT

IS SYSTEM 110 ?

NO

YES

SET 110 V FLAG

SET 220 V FLAG

TO SPA
CONTROL
PANEL 12

66 — POWER SUPPLY

60 — OPTO-ISOLATORS [ZERO CROSSING CIRCUITRY]

63 — ACCESS DOOR SAFETY INTERLOCK

64 — GFCI PROTECTION

16

110/220 VAC

62 — TRIACS

70 — FIELD CONNECTION BOARD

71 — CONNECTOR — SPA LIGHT — 30

71 — CONNECTOR — HEATER CORE — 26

71 — CONNECTOR — BLOWER MOTOR — 28

71 — CONNECTOR — PUMP MOTOR (2 SPEED) — 24

FIG. 3

TIMER INTERRUPT

↓

POLL KEYBOARD

↓

POLL RTO

↓

READ ANALOG INPUT

↓

CONVERT TO ENG. UNITS

↓

DONE

FIG. 12

POWER FAIL

↓

WRITE EXT. RAM TO EEROM

↓

TURN OFF ALL CONTROLS

↓

DISPLAY FAIL

↓

LATCH POWER FAIL

↓

POWER FAIL ?

YES →

NO ↓

SIMULATE RESET

FIG. 13

SPA CONTROL PANEL

69 —○ ʃʃʃʃʃ

12:36 — 46

61 — ⌖

59

54 —

52   52   50   50   50

57

67

49   51   53   65   55   63

— 48

12

FIG. 5

OVERALL FLOW OR CONTROL

RESET —100

INITIALIZATION —102

MAIN PROGRAM —104

INTERRUPTS ENABLED

TIMER INTERRUPT —106

POWER-ALL INTERRUPT —108
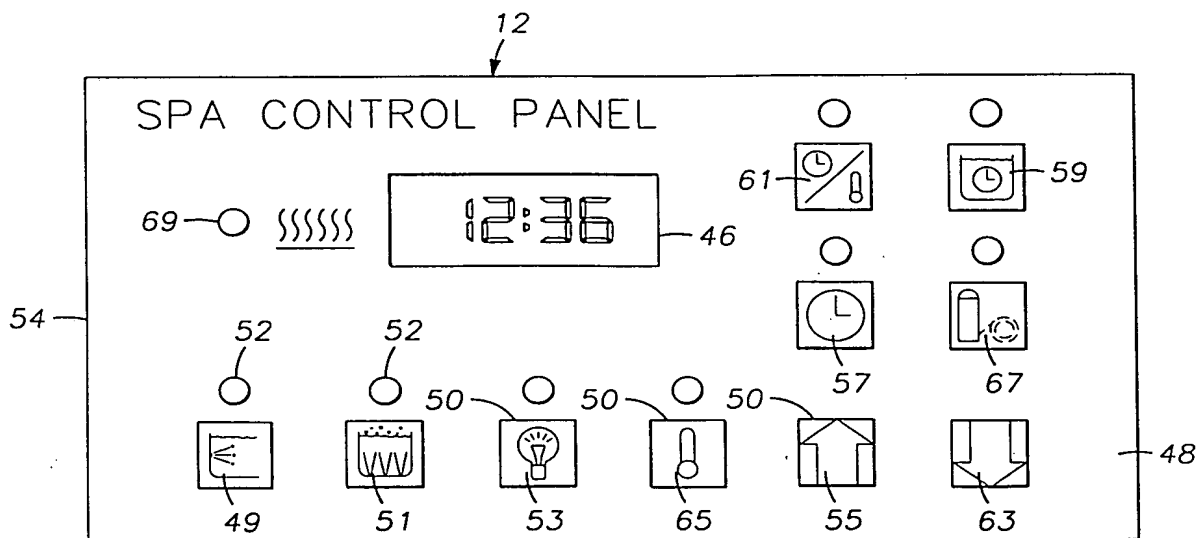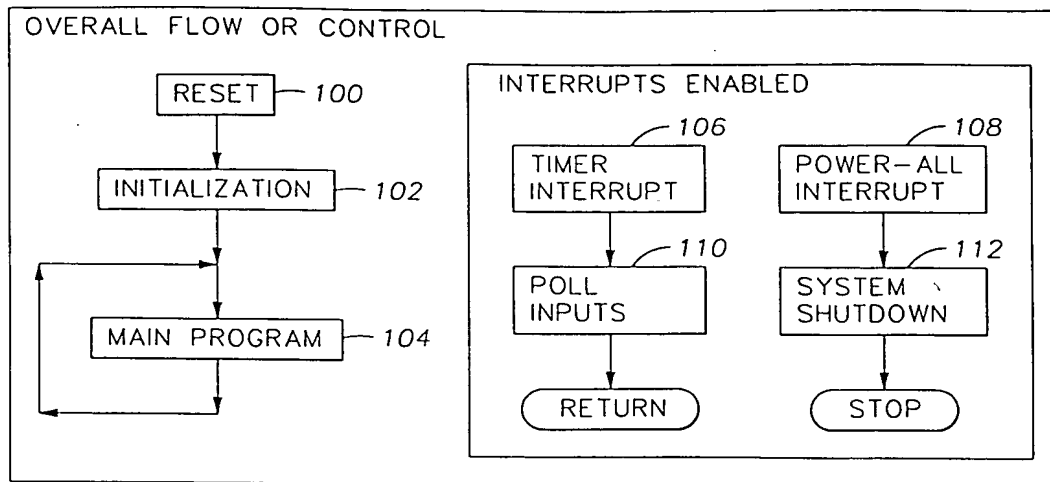
POLL INPUTS —110

SYSTEM SHUTDOWN —112

RETURN

STOP

FIG. 6

$TEMP_F$ = DESIRED TEMPERATURE OF SPA WATER
$TEMP_1$ = TEMPERATURE AT FIRST SENSOR (S_1)
$TEMP_2$ = TEMPERATURE AT SECOND SENSOR (S_2)
$TEMP_\Delta$ = $TEMP_1 - TEMP_2$
Δ_L = LIMIT OF ACCEPTABLE TEMPERATURE DIFFERENCE (+ OR −)

READ $TEMP_1$ AND $TEMP_2$

CALCULATE $TEMP_\Delta$

$TEMP_\Delta \geq \Delta_L$?

OPERATE HEATER (26) NO

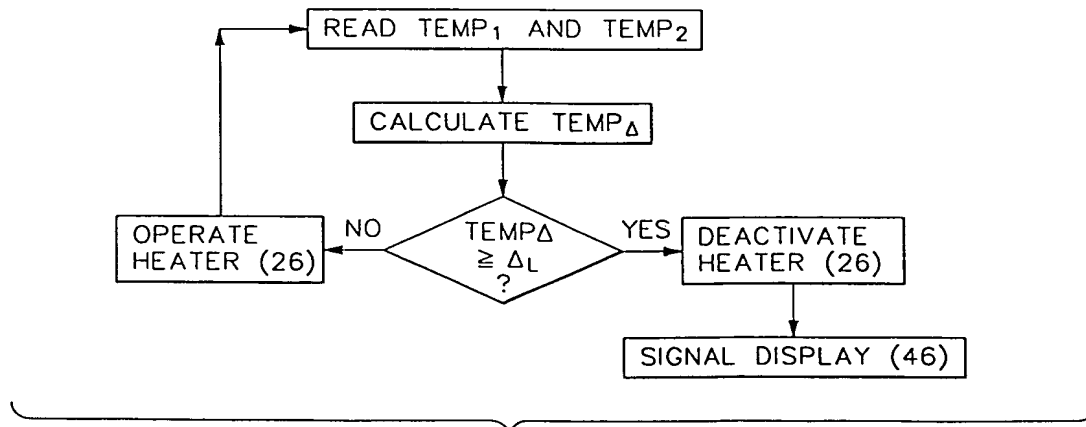YES DEACTIVATE HEATER (26)

SIGNAL DISPLAY (46)

FIG. 7

RATE = RATE OF HEATING

$RATE_{AV}$ = RATE OF HEATING (AVERAGE)

$TEMP_I$ = INITIAL TEMPERATURE OF SPA WATER

$TEMP_F$ = DESIRED TEMPERATURE OF SPA WATER

$TEMP_\Delta$ = $TEMP_F - TEMP_I$

$TIME_I$ = TIME (INITIAL)

$TIME_F$ = TIME (FINAL)

$TIME_\Delta$ = $TIME_F - TIME_I$

```
        ┌──────────────────┐
        │   READ  TEMP_I    │
        └──────────────────┘
                 │
                 ▼
        ┌──────────────────┐
        │   READ  TIME_I    │
        └──────────────────┘
                 │
                 ▼
   ┌────────────────────────┐◄─────────────┐
   │  ACTIVATE  HEATER (26) │              │
   └────────────────────────┘              │
                 │                         │
                 ▼                         │
             ╱───────╲          NO   ┌───────────┐
            ╱  TEMP_F  ╲─────────────►│ CONTINUE  │
            ╲    ?     ╱              └───────────┘
             ╲───────╱
                 │ YES
                 ▼
        ┌──────────────────┐
        │ CALCULATE  TIME_Δ │
        └──────────────────┘
                 │
                 ▼
        ┌──────────────────┐
        │ CALCULATE  RATE_AV│
        └──────────────────┘
                 │
                 ▼
        ┌──────────────────┐
        │    STORE RATE     │
        └──────────────────┘
```
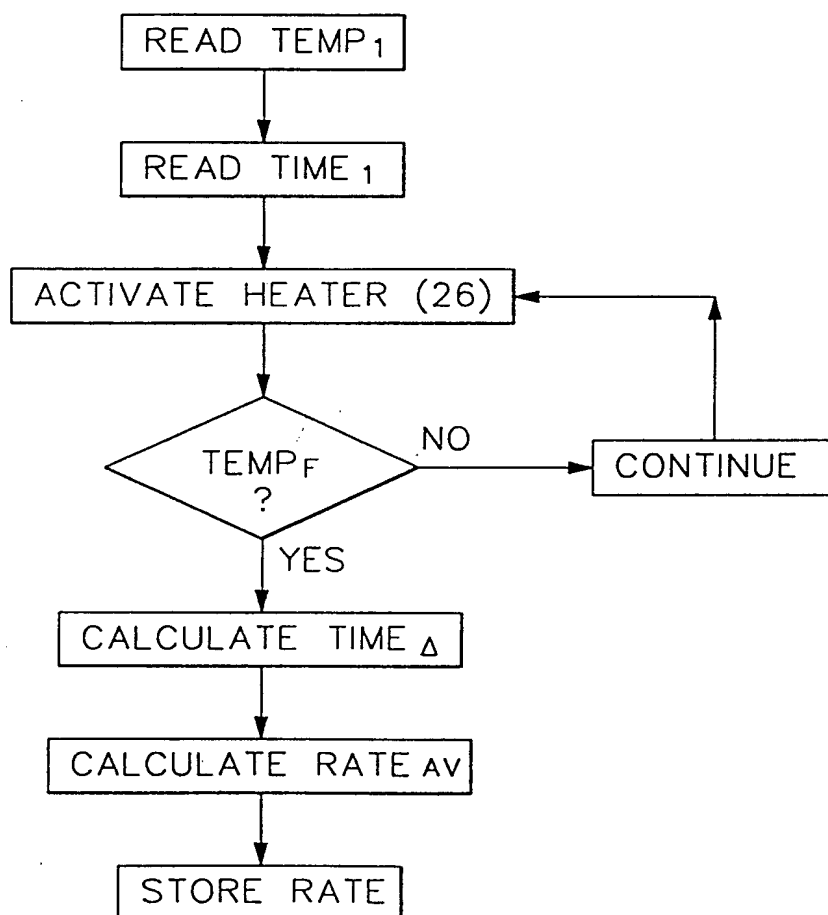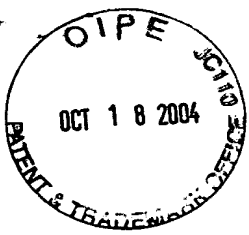
FIG. 9

$TEMP_I$ = INITIAL TEMPERATURE OF SPA WATER
$TEMP_F$ = FINAL (DESIRED) TEMPERATURE OF SPA WATER
$TEMP_\Delta$ = $TEMP_F - TEMP_I$
RATE = RATE OF HEATING
$RATE_{AV}$ = RATE OF HEATING (AVERAGE)
$TIME_I$ = TIME (INITIAL)
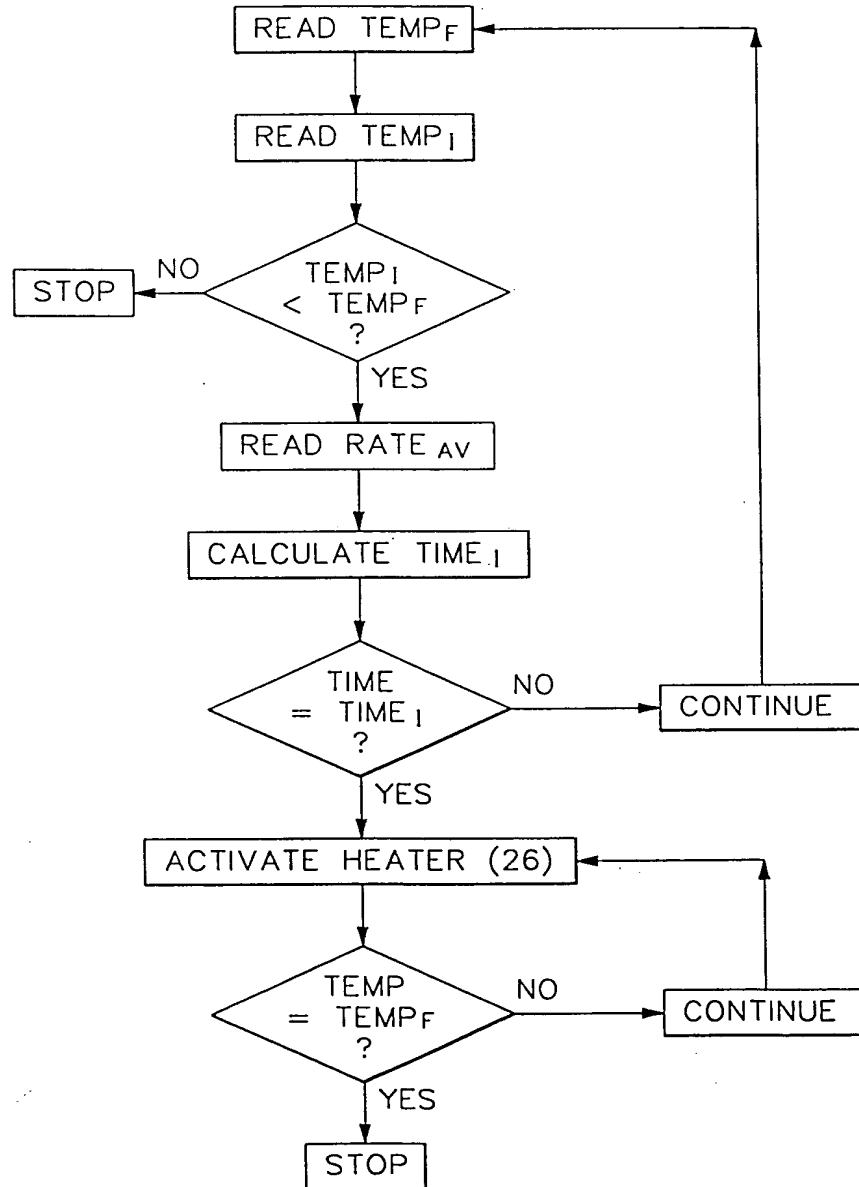$TIME_F$ = TIME (FINAL)
$TIME_\Delta$ = $TIME_F - TIME_I$

READ $TEMP_F$
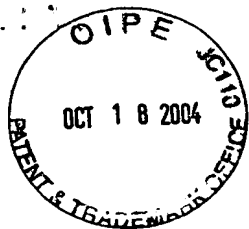
READ $TEMP_I$

$TEMP_I < TEMP_F$? — NO → STOP

YES

READ $RATE_{AV}$

CALCULATE $TIME_I$

TIME = $TIME_I$? — NO → CONTINUE

YES

ACTIVATE HEATER (26)

TEMP = $TEMP_F$? — NO → CONTINUE

YES

STOP

FIG. 10

POWER UP RESET

CLEAR RAM

TURN ALL OUTPUTS AND CONTROLS OFF

TEST & INITIALIZE:
- DISPLAY
- RTC
- KEYBOARD
- RAM
- EPROM
- TIMER

WAIT 15 TIMER CYCLES

SYNC WITH TIMER

FIG. 11

RUN
- BUZZER
- FLASHER

PERFORM SYSTEM CONTROLS

SET KEYBOARD DATA

OUTPUT STATE DISPLAY

KEY PRESSED ?   NO

YES

RING BUZZER

HANDLE CONTROL KEYS

HANDLE STATE KEYS

HANDLE FUNCTION KEYS